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LISTS OF SPECIES

Squamate Reptiles from municipality of Barcarena and surroundings, state of Pará, north of Brazil

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ABSTRACT: We present the first species list of squamate reptiles of the municipality of Barcarena and surroundings, in state of Pará, north of Brazil. The study area is dominated by secondary florest at different successional stages. The list was drawn up as a result of data obtained from specimens deposited in the Herpetological Collection of the Museu Paraense Emílio Goeldi and inventories of the herpetofauna conducted in the Barcarena region. This list comprises 17 families (Amphisbaenia: Amphisbaenidae; Sauria: Gekkonidae, Gymnophthalmidae, Iguanidae, Phyllodactylidae, Polychrotidae, Scincidae, Sphaerodactylidae, Teiidae, Tropiduridae; Serpentes: Aniliidae, Boidae, Colubridae, Dipsadidae, Elapidae, Typhlopidae and Viperidae), 44 genera and 59 species of squamate reptiles.

INTRODUCTION

The herpetofauna of the Brazilian Amazonia encompasses about 78% of the reptile species from the whole Amazonia region (Ávila-Pires *et al*. 2007). A considerable part of the 721 reptile species occurring at Brazil (Bérnils 2010), is present in the Amazon Rainforest (Ávila-Pires *et al.* 2007) and these numbers are growing every year due to the regular descriptions of new species (*e.g*. Prudente and Santos-Costa 2006; Passos and Fernandes 2008; Santos Jr. *et al*. 2008; Zaher *et al.* 2008).

However, the gaps of knowledge concerning the Amazonian herpetofauna include several aspects like as composition and geographic distribution, endemism and population dynamics (Azevedo-Ramos and Galatti 2002). In addition, knowledge of species distribution enables descriptions patterns of geographic distributions and their ecological meaning (*e.g*. inferences of environmental variables; Silva-Jr *et al.* 2009) and/or historical events (Cadle and Greene 1993).

This study represents an important contribution towards the understanding of the Amazonian herpetofauna considering that the study area is located in the deforestation arc and that the Amazon Rainforest is one of the Brazilian biomes with the highest rates of deforestation of native forests (Nepstad *et al*. 1999). Here we provide a checklist of the amphisbaenia, sauria and Serpentes species for an area of the Amazonia forest, located in the municipality of Barcarena, northeast of the state of Pará, Brazil. The species list was based on data obtained from the inventories of the herpetofauna conducted in Barcarena and the herpetological collection of the Museu Paraense Emílio Goeldi (MPEG).

MATERIALS AND METHODS

Study site

The study was developed at the municipality of Barcarena (01°30'24" S, 48°37'12" W; 15 meters above sea level), state of Pará, Brazil (Figure 1).

The local climate is hot equatorial with Köppen classification type Am. The mean annual temperature is 27°C with minimal thermal amplitude. Annual rainfall exceeds 2,500 mm, with a rainy season between January and June and dryer months towards the end of the year (Souza and Lisboa 2005).

The study area encompasses an area of about 1,316.2 km^2 currently composed of secondary forests (copse) at different successional stages. Most of the primitive vegetation has been replaced by subsistence agricultural species by means of deforestation. Lowland forests, flooded forests, upland forests, sandy meadows and sandy river beaches also make up the plant cover of the municipality (Souza and Lisboa 2006).

Data acquisition

The inventories of local herpetofauna were conducted in Barcarena at 2001 (19 to 26 November), 2002 (22 to 27 March), 2006 (19 to 25 October) and 2009 (March to May).

The habitats were classified into the following categories: Primary Forest: vegetation without significant human disturbance, consisting of medium-sized and large trees (Figure 2A); Disturbed area: degraded areas or areas in early stages of plant regeneration after suffering great human action (Figure 2B); Igarapé: area of gallery forest along watercourses located in lowlands (Figure 2C); Freshwater Beach: area with vegetation characterized by either small, medium-sized or large trees (Figure 2D).

Below, we describe each locality sampled in Barcarena and surroundings (Figure 1):

A) Reserva Particular do Patrimônio Natural (RPPN) Samaúma (01°29'51" S, 48°42'40" W). Primary forest.

B) Pousada Japiim (01°30'43" S, 48°42'30" W). Primary forest and disturbed areas.

C) Trambioca Island (01°26'00" S, 48°32'00" W). Primary and secondary forest as well as disturbed areas.

D) Rodovia PA 151, Belém-Abaetetuba (01°38'38" S,

48°39'37" W). Primary and lowland forest.

E) Arienga River (Highway to Santa Rosa District) (01°37'00" S, 48°43'00" W). Primary, secondary and lowland forest close to Arienga River.

F) Linhão Eletronorte (01°39'51" S, 48°44'55" W). Sampling was made along the transmission line in secondary forest and open areas.

G) Igarapé Curuperé (01°34' S; 48°45' W).

H) Quadrado and Pátio do Carvão area (1°37' S; 48°45' W). Secondary forest and disturbed areas.

I) Area under influence of the Projeto Fauna, Refinaria ABC – Monitoring 1 (01°35'09" S, 48°43'43" W; 01°35'56" S, 48°43'38" W).

J) Area under influence of the Projeto Fauna, Refinaria ABC – Monitoring 2 (01°36'14" S, 48°43'50" W). Secondary forest.

K) Area under influence of the Projeto Fauna, Refinaria ABC – Rescue Area (01°35'12" S, 48°43'46" W; 01°35'27" S, 48°43'42" W). Secondary forest and disturbed areas.

L) Surroundings areas of Barcarena. In these areas we included specimens collected by incidental encounters where specific data and geographical coordinates are missing.

Sampling methods included pitfall traps with drift fences, time-limited searches, and incidental encounters (Martins and Oliveira 1998). The pitfall traps were installed in areas G, H and I in two distinct sets. The first set was a 300 m line, with thirty 60 L buckets, 10 m apart from one another and connected by a plastic fence guide. The second set consisted of four 60 L buckets, seven meters apart from one another connected by a plastic fence guide, forming a "Y" shape. In areas J and K we installed three sets of traps, each 100 m long, containing twenty paired 60 L buckets interconnected by a plastic fence guide, 10 m apart from one another. The traps were checked daily. The buckets remained open until the end of each field trip. Thus, in total, each set of traps remained open for 37 days, totaling 2,544 bucket-hours.

The time-limited search was made in A to H areas. The search lasted 4 h per day (2 h in the morning and 2 h at night), and was done by two people. Thus, in total, each area had the same sampling effort of 336 man-hours (16 man-hours/day × 21 days).

Incidental encounters are represented by all specimens found in the study site that do not fit in the other two methods mentioned above, including specimens that had been run over.

We complete the data with specimens deposited in the Herpetological Collection of the Museu Paraense Emílio Goeldi (MPEG), between 1980 and 2000.

All collected specimens were deposited at the Herpetological Collection of the Museu Paraense Emílio Goeldi (MPEG), Belém, Pará, Brazil. Permission # 007/2009 / Process 353613/2007 conceded by SEMA – PA.

Results and Discussion

We recorded 59 species of squamate reptiles for the municipality of Barcarena and surrounding areas, belonging to 17 families and 44 genera represented by Amphisbaenia with one family (one genera and two species); Sauria with nine families (15 genera and 17 species); and Serpentes with seven families (28 genera and 40 species) (Table 1).

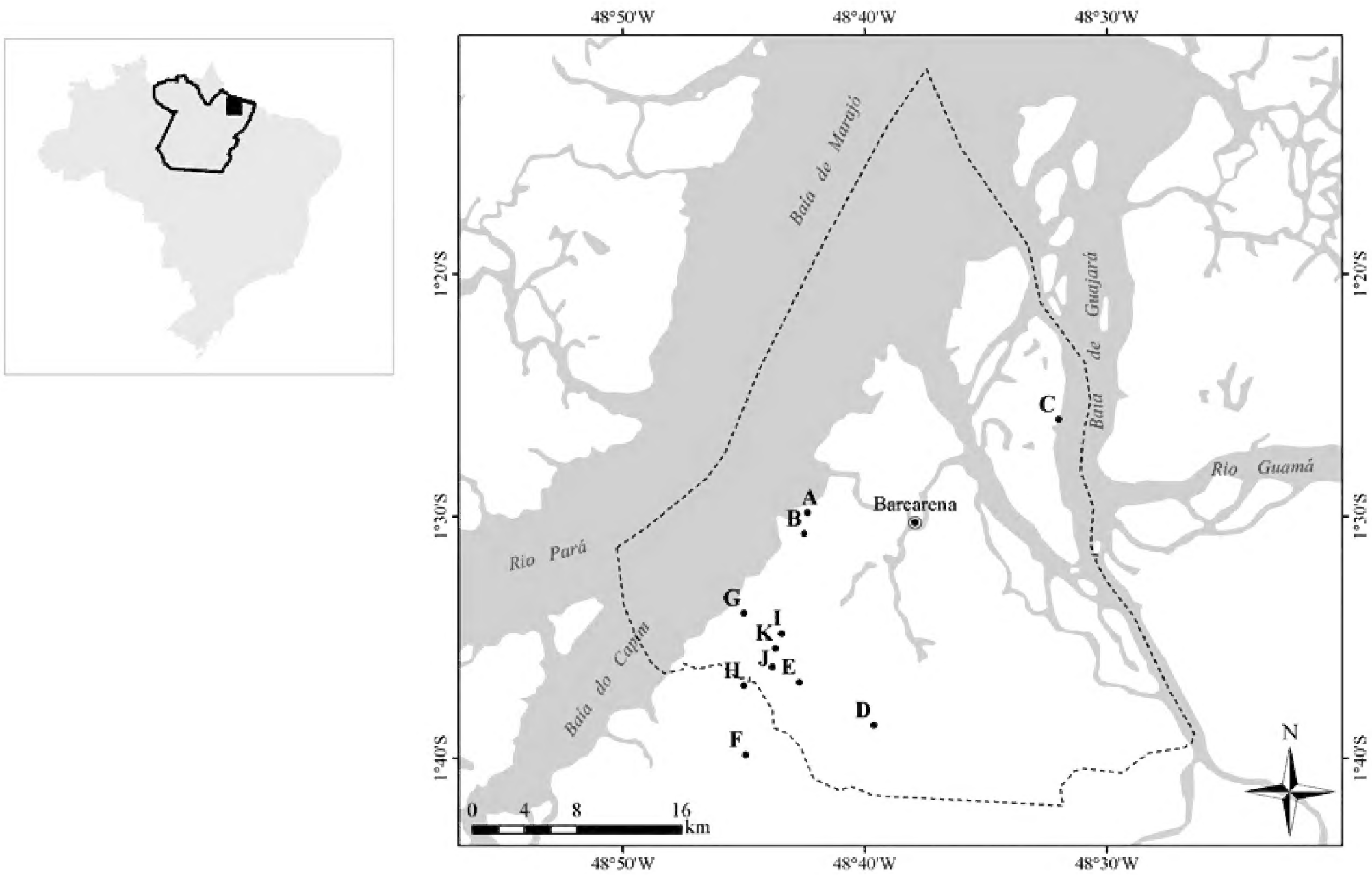

Figure 1. Map showing the city boundaries (dashed) of Barcarena, State of Pará, Brazil and the localities sampled in the region (A to K).

Amongst the lizards, Polychrotidae with four species (23% of total number of species) and Teiidae with three species (17% of total number of species) were the families with highest species richness, followed by Gymnophthalmidae, Sphaerodactylidae and Tropiduridae with two species each (12% of total species). For the families Gekkonidae, Iguanidae, Phyllodactylidae and Scincidae only one species was recorded (6% of total species).

The most abundant species of lizards were *Gonatodes humeralis*, *Anolis fuscoauratus*, *Kentropyx calcarata* and *Mabuya nigropunctata*. *Gonatodes humeralis*, one of the most common lizards in the Amazon region, is diurnal and inhabits various types of environments (*e.g.* terra firme, floodplains, or igapó; primary or secondary forest; gallery forest). It is an abundant species in disturbed Amazonia Rainforest and gallery forests of Central Brazil (Ávila-Pires 1995; Vitt *et al.* 2008). Similarly to *G. humeralis*, *Anolis fuscoauratus* is commonly found in the Amazon region and in disturbed areas. This species is distributed throughout most of northern South America east of the Andes and the Atlantic Forest of eastern Brazil (Vitt *et al.* 2008). *Kentropyx calcarata* and *Mabuya nigropunctata* are heliothermic lizards that inhabit the interior of tropical rainforests, although they can often be found in forest edges and clearings. Both species have wide distribution throughout the Brazilian Amazonia, also occurring in the Brazilian Atlantic Forest (Vitt *et al.* 1997; 2008).

For the family Amphisbaenidae only *Amphisbaena amazonica* and *Amphisbaena mitchelli* were recorded for the area. This low number is probably related to the fossorial habits of these species, which makes them difficult to sample. *Amphisbaena amazonica* can be found throughout the Brazilian Amazonia and in the southeast of Colombia (Gans 2005), and open areas of the Brazilian Cerrado (savannah-like vegetation) (Colli *et al.* 2002), whilst *A. mitchelli* is reported for the state of Pará (Vanzolini 2002).

In total, we collected 40 species of snakes distributed in seven families and 27 genera. The family Dipsadidae (*sensu* Zaher *et al.* 2009) with 17 species (41% of the total number) and Colubridae with 10 species (26% of the total number) had the highest species richness, followed by the families Boidae and Elapidae, with five species each (13% of the total). Only one species was recorded for the families Typhlopidae (*Typhlops reticulatus*), Aniliidae (*Anilius scytale*) and Viperidae (*Bothrops atrox*).

Bothrops atrox was the most abundant snake species in the region of Barcarena, followed by *Oxybelis aeneus* and *Siphlophis cervinus*. Although snakes are relatively

FIGURE 2. The environments sampled in the region of Barcarena and surroundings, State of Pará, Brazil. A, Primary forest; B, Disturbed area; C, Igarapé; D, Beach.

common in the Amazon region, *Typhlops reticulatus* and *Anilius scytale* showed the lowest abundance in the region.

The large number of records of *Bothrops atrox* for the studied region was expected because, according to Duellman (1978), Cunha and Nascimento (1978), Dixon and Soini (1986) and Martins and Oliveira (1998) this species is one of the most abundant in the Amazon region.

The low abundance of *Typhlops reticulatus* and *Anilius scytale* is due in part to the fossorial or semi-fossorial habit of these species, making it difficult to visualize and capture them. The record of *Typhlops reticulatus* is consistent with the known distribution, which extends from eastern and southern Venezuela (the whole northern part of South America east of the Andes) to the Brazilian Amazonia, as well as an isolated population in northeastern Brazil (Dixon and Hendricks 1979; Cunha and Nascimento 1993; Rodrigues and Juncá 2002). *Anilius scytale* is also a species commonly found in the Amazonia Rainforest (Dixon and Soini 1977; 1986; Duellman 1978; Cunha and Nascimento 1978; 1981; 1993; Martins and Oliveira 1998; Maschio *et al.* 2007), although it has also been recorded in deforested areas, in areas of Cerrado (states of Goiás and Mato Grosso, Brazil), and in humid forest enclaves within the Caatinga region (State of Ceará, Brazil) (Silva-Jr 2001).

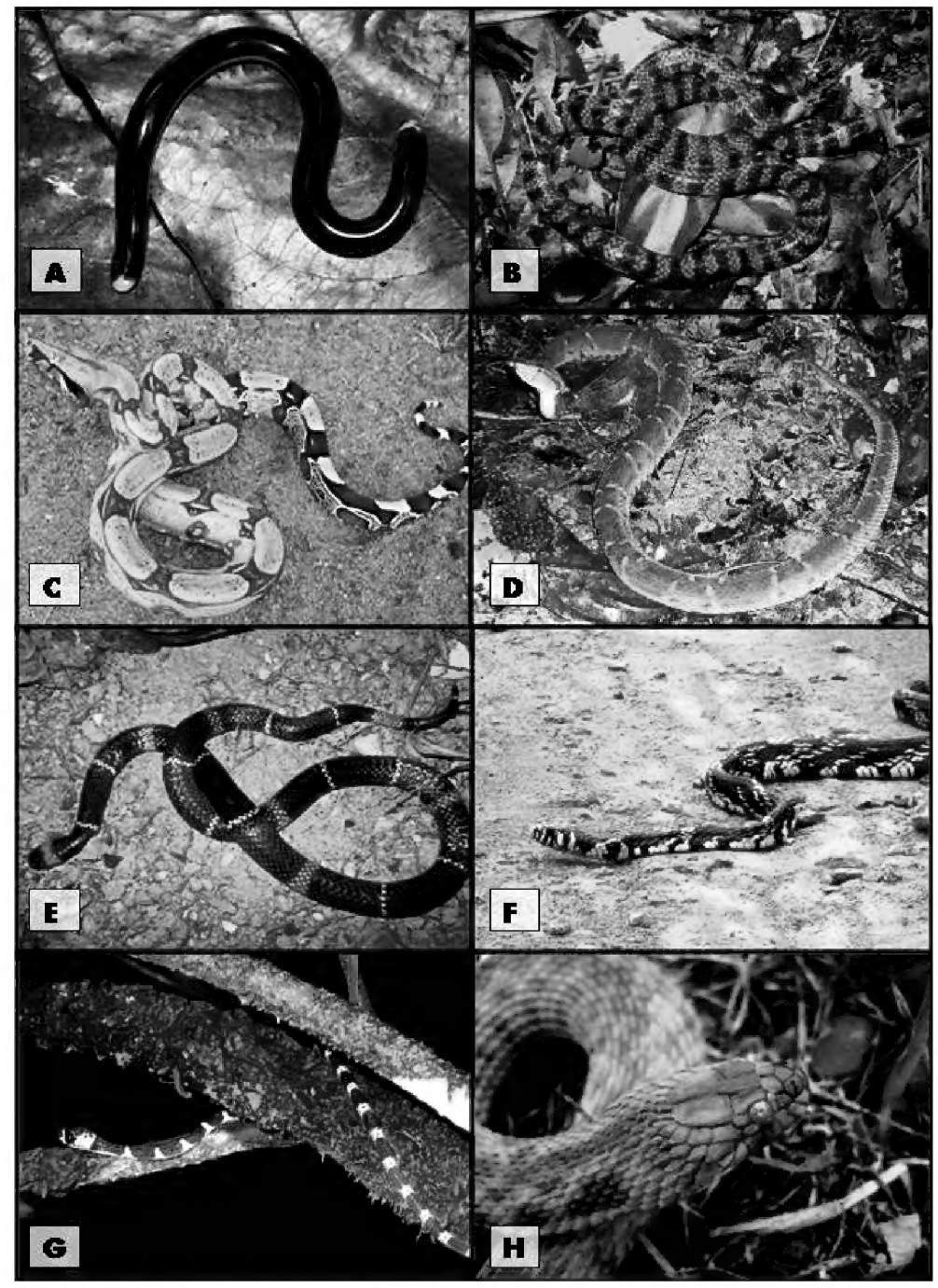

FIGURE 3. Some snake species recorded in the municipality of Barcarena and surroundings, State of Pará, Brazil. A, *Typhlops reticulatus* (Photo by A. Araújo); B, *Anilius scytale* (Photo by G. Maschio); C, *Boa constrictor* (Photo by G. Maschio); D, *Bothrops atrox*; E, *Micrurus hemprichii*; F, *Spilotes pullatus* (Photo by S. Dantas); G, *Dipsas pavonina*; H, *Helicops polylepis*.

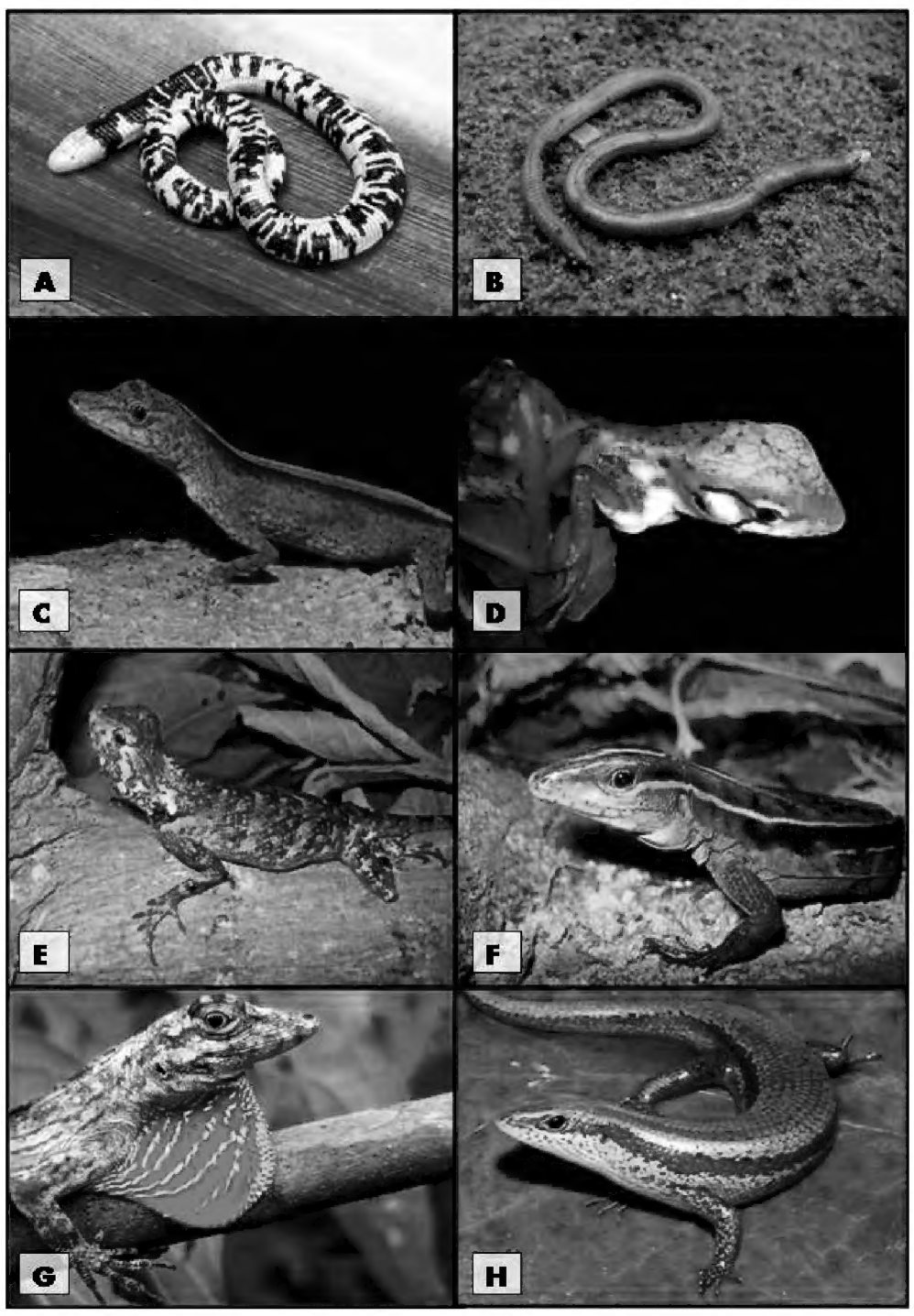

FIGURE 3. Some species of amphisbaenians and lizards from Barcarena and surroundings, State of Pará, Brazil. A, *Amphisbaena amazonica*; B, *Amphisbaena mitchelli*; C, *Anolis fuscoauratus* (Photo by P. Peloso); D, *Polychrus marmoratus* - juvenile; E, *Plica umbra*; F, *Kentropyx calcarata*; G, *Anolis ortonii*; H, *Mabuya nigropunctata* (Photo by P. Peloso).

Of the 243 species of Squamata present in the Brazilian Amazonia (Ávila-Pires *et al.* 2007), 24% were recorded for the region of Barcarena and surrounding areas, for which the vast majority of snakes (71%), lizards (76%) and amphisbaenians (100%) was recorded in secondary forest and open disturbed areas. The primary forest was responsible for 23% of the species of lizards and 12% of the snakes, whilst in the other environments (Igarapés and beaches) 14% and 2% of snakes were recorded, respectively.

These results reflect the general state of environmental change that is occurring in the whole region, which is why this inventory is an important contribution to the knowledge and conservation of the Squamata fauna in the Amazon Rainforest biome.

Table 1. Reptiles recorded in the municipality of Barcarena and surroundings, state of Pará, Brazil. Localities: A, Reserva Particular do Patrimônio Natural (RPPN) Samaúma; B, Pousada Japiim; C, Trambioca Island; D, Rodovia PA 151, Belém-Abaetetuba; E, Arienga River; F, Linhão Eletronorte area; G, Igarapé Curuperé; H, Quadrado and Pátio do Carvão area; I, Area under influence of the Projeto Fauna, Refinaria ABC – Monitoring 1; J, Area under influence of the Projeto Fauna, Refinaria ABC – Monitoring 2; K, Area under influence of the Projeto Fauna, Refinaria ABC – Rescue Area; L, Areas adjacent to Barcarena. Habitats: PF - Primary Forest; DA - Disturbed Area; IG - Igarapé; BE – Beach. Exclamation mark (?) - not recorded.

TAXON	SPECIES	DATA COLLECTION	THIS STUDY	HABITAT	LOCALITY
AMPHISBAENIA					
Amphisbaenidae	*Amphisbaena amazonica* Vanzolini, 1951		1	DA	H
	Amphisbaena mitchelli Procter, 1923		1	DA	K
SAURIA					
Gekkonidae	*Hemidactylus mabouia* (Moreau de Jonnès, 1818)		1	DA	A
Gymnophthalmidae	*Alopoglossus angulatus* (Linnaeus, 1758)		3	DA	D, G
	Leposoma percarinatum (Müller, 1923)		3	DA	G, I
Iguanidae	*Iguana iguana* (Linnaeus, 1758)		visual record	DA	K
Phyllodactylidae	*Thecadactylus rapicauda* (Houttuyn, 1782)		2	DA	K
Polychrotidae	*Anolis fuscoauratus* (Duméril & Bibron, 1837)		16	DA	K
	Anolis ortonii Cope, 1869		1	DA	H
	Anolis punctatus Daudin, 1802		1	DA	F
	Polychrus marmoratus (Linnaeus, 1758)		4	DA	D, K
Scincidae	*Mabuya nigropunctata* (Spix, 1825)		11	DA	A, C, H, K
Sphaerodactylidae	*Coleodactylus amazonicus* (Andersson, 1918)		5	PF, DA	A, J, K, L
	Gonatodes humeralis (Guichenot, 1855)		22	PF, DA	A, B, C, G, K
Teiidae	*Ameiva ameiva* (Linnaeus, 1758)		3	DA	H, I, K
	Cnemidophorus lemniscatus (Linnaeus, 1758)		8	DA	F, K
	Kentropyx calcarata Spix, 1825	1	15	PF, DA	A, D, E, G, H, J, L
Tropiduridae	*Plica umbra* (Linnaeus, 1758)	1	7	PF, DA	A, G, H, J, K
	Uranoscodon superciliosus (Linnaeus, 1758)		4	DA	G, H, K
SERPENTES					
Aniliidae	*Anilius scytale* (Linnaeus, 1758)	2		IG	L
Boidae	*Boa constrictor* Linnaeus, 1758	3	1	DA	K, L
	Corallus caninus (Linnaeus, 1758)	1		?	L
	Corallus hortulanus (Linnaeus, 1758)		3	PF, DA	A, K, L
	Epicrates cenchria (Linnaeus, 1758)	1		?	L
	Eunectes murinus (Linnaeus, 1758)	2		?	L
Colubridae	*Chironius exoletus* (Linnaeus, 1758)		1	DA	K
	Dendrophidion dendrophis (Schlegel, 1837)		3	DA	K
	Drymoluber dichrous (Peters, 1863)		1	DA	K
	Leptophis ahaetulla (Linnaeus, 1758)	2	3	DA	K, L
	Mastigodryas boddaerti (Sentzen, 1796)	1	5	DA	K
	Oxybelis aeneus (Wagler, 1824)	1	8	PF, DA	D, K
	Oxybelis fulgidus (Daudin, 1803)	2	1	DA	K, L
	Pseustes poecilonotus (Günther, 1858)	2	6	DA	C, K, L
	Spilotes pullatus (Linnaeus, 1758)	1		?	L
	Tantilla melanocephala (Linnaeus, 1758)	2	5	DA, IG	K, L

Table 1. ***Continued.***

TAXON	SPECIES	DATA COLLECTION	THIS STUDY	HABITAT	LOCALITY
	Apostolepis quinquelineata Boulenger, 1896	2		DA	L
	Atractus schach (Boie, 1827)		1	DA	K
	Dipsas catesbyi (Sentzen, 1796)		2	DA	K
	Dipsas pavonina Schlegel, 1837	1	2	DA	K, L
	Helicops angulatus (Linnaeus, 1758)		1	IG	L
	Helicops hagmanni Roux, 1910	1		IG	L
	Helicops polylepis Günther, 1861	2		IG	L
	Imantodes cenchoa (Linnaeus, 1758)	1	4	PF, DA	A, K, L
Dipsadidae	*Imantodes lentiferus* (Cope, 1894)		1	DA	K
	Leptodeira annulata (Linnaeus, 1758)		2	DA	K
	Liophis reginae (Linnaeus, 1758)		1	DA	K
	Liophis typhlus (Linnaeus, 1758)		1	DA	D
	Philodryas argenteus (Daudin, 1803)	1		DA	L
	Philodryas viridissima (Linnaeus, 1758)	1		?	L
	Pseudoboa coronata Schneider, 1801	1	2	DA	K, L
	Siphlophis cervinus (Laurenti, 1768)	2	5	DA, BE	A, K, L
	Xenodon rhabdocephalus (Wied, 1824)	1		?	L
	Micrurus filiformis (Günther, 1859)		2	DA	L
	Micrurus hemprichii (Jan, 1858)		1	DA	K
Elapidae	*Micrurus lemniscatus* (Linnaeus, 1758)	2		IG	L
	Micrurus paraensis Cunha & Nascimento, 1973		1	DA	K
	Micrurus surinamensis (Cuvier, 1817)	4		IG	L
Typhlopidae	*Typhlops reticulatus* (Linnaeus, 1758)		1	DA	K
Viperidae	*Bothrops atrox* (Linnaeus, 1758)	8	11	PF, DA	A, B, C, F, K

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Appendix 1. Voucher specimens.

Amphisbaenia: *Amphisbaena amazonica* (MPEG 24293); *Amphisbaena mitchelli* (MPEG 27000). **Sauria**: *Alopoglossus angulatus* (MPEG 19902, 19903, 24290); *Ameiva ameiva* (MPEG 24268, 27042, 27043); *Anolis fuscoauratus* (MPEG 27001 to 27013, 27021 to 27023); *Anolis ortonii* (MPEG 24289); *Anolis punctatus* (MPEG 19906); *Cnemidophorus lemniscatus* (MPEG 19904, 19905, 26994 to 26999); *Coleodactylus amazonicus* (MPEG 19891, 20206, 27025 to 27027); *Gonatodes humeralis* (MPEG 19892, 19895, 19896, 19898, 19901, 19910, 19978, 19979, 20202 to 20205, 20239, 20240, 24272, 24273, 27016 to 27020); *Hemidactylus mabouia* (MPEG 19897); *Kentropyx calcarata* (MPEG 16131, 19894, 19907, 19908, 20208, 24278 to 24285, 27028 to 27030); *Leposoma percarinatum* (MPEG 24291, 24292, 27024); *Mabuya nigropunctata* (MPEG 19893, 19899, 19900, 24286 to 24288, 27033 to 27037); *Plica umbra* (MPEG 16132, 20207, 20209, 24274 to 24277, 27015); *Polychrus marmoratus* (MPEG 27038 to 27041); *Thecadactylus rapicauda* (MPEG 27031, 27032); *Uranoscodon superciliosus* (MPEG 24269 to 24271, 27014). **Serpentes**: *Anilius scytale* (MPEG 16627, 18293); *Apostolepis quinquelineata* (MPEG 16339, 17292); *Atractus schach* (MPEG 23451); *Boa constrictor* (MPEG 18441, 18442, 18504, 23604); *Bothrops atrox* (MPEG 18495, 18500, 18507, 18617, 18757, 18768, 18769, 19025, 19419, 20032, 20037, 20038, 23403 to 23409); *Chironius exoletus* (MPEG 23445); *Corallus caninus* (MPEG 16424); *Corallus hortulanus* (MPEG 20187, 23440, 23441); *Dendrophidion dendrophis* (MPEG 23417); *Dipsas catesbyi* (MPEG 23434, 23435); *Dipsas pavonina* (MPEG 16455, 23436, 23437); *Drymoluber dichrous* (MPEG 23453); *Epicrates cenchria* (MPEG 18502); *Eunectes murinus* (MPEG 16443, 18506); *Helicops angulatus* (MPEG 18494); *Helicops hagmanni* (MPEG 20655); *Helicops polylepis* (MPEG 16337, 16440); *Imantodes cenchoa* (MPEG 16471, 20035, 20036, 23432); *Imantodes lentiferus* (MPEG 23433); *Leptodeira annulata* (MPEG 23447, 23448); *Leptophis ahaetulla* (MPEG 15453, 16567, 23447 to 23449, 23450); *Liophis reginae* (MPEG 23452); *Liophis typhlus* (MPEG 20039); *Mastigodryas boddaerti* (MPEG 16370, 23422 to 23426); *Micrurus filiformis* (MPEG 18497, 18498); *Micrurus hemprichii* (MPEG 23455); *Micrurus lemniscatus* (MPEG 18444, 18687); *Micrurus paraensis* (MPEG 23456); *Micrurus surinamensis* (MPEG 18309, 18501, 18510, 18751); *Oxybelis aeneus* (MPEG 18505, 20040, 23410, 23415, 23603); *Oxybelis fulgidus* (MPEG 18443, 18763, 23416); *Philodryas argenteus* (MPEG 16453); *Philodryas viridissima* (MPEG 16338); *Pseudoboa coronata* (MPEG 18503, 23438, 23439); *Pseustes poecilonotus* (MPEG 16409, 16429, 20033, 20678, 23442 to 23444, 23454); *Siphlophis cervinus* (MPEG 16347, 16431, 18496, 18688, 20034, 23420, 23421); *Spilotes pullatus* (MPEG 16412); *Tantilla melanocephala* (MPEG 18276, 18499, 23427 to 23431); *Typhlops reticulatus* (MPEG 23640); *Xenodon rabdocephalus* (MPEG 18778).